

Presence of Contaminants in the Colorado River Delta Ecosystems

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Background

- Currently waterborne toxic chemicals pose the greatest threat to the safety of water supplies (groundwater, rivers, lakes)
- Some specific pollutants include chlorinated hydrocarbons, heavy metals, saline water, bacteria and general municipal and industrial wastes

Water pollutants and their significance

Class of pollutant	Significance
Trace elements	Health, aquatic biota, toxicity
Radionuclides	Toxicity
Asbestos	Human health
Algal nutrients	Eutrophication
Acidity, alkalinity, salinity (in excess)	Water quality, aquatic life
Trace organic pollutants	Toxicity
Polychlorinated biphenyls	Possible biological effects
Pesticides	Toxicity, aquatic biota, wildlife
Petroleum wastes	Effect on wildlife, esthetics
Sewage, human and animal wastes, BOD	Water quality, oxygen levels
Pathogens	Health effects
Detergents	Eutrophications, wildlife, esthetics
Chemical carcinogens	Incidence of cancer
Sediments	Water quality, aquatic biota, wildlife
Taste, odor, and color	Esthetics

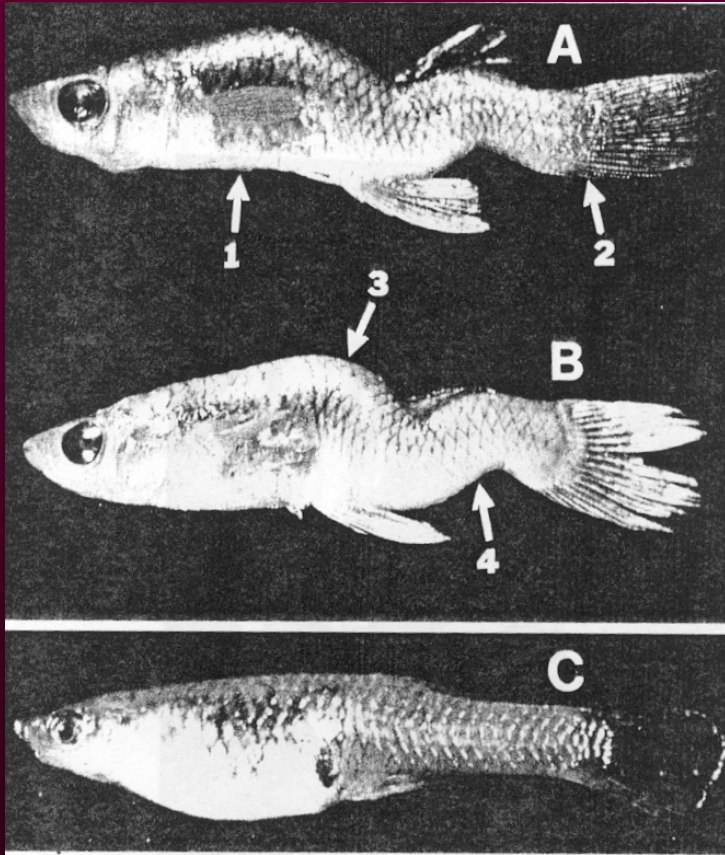
- I will focus this presentation in the characterization of contaminants that have the potential to be harmful to wildlife



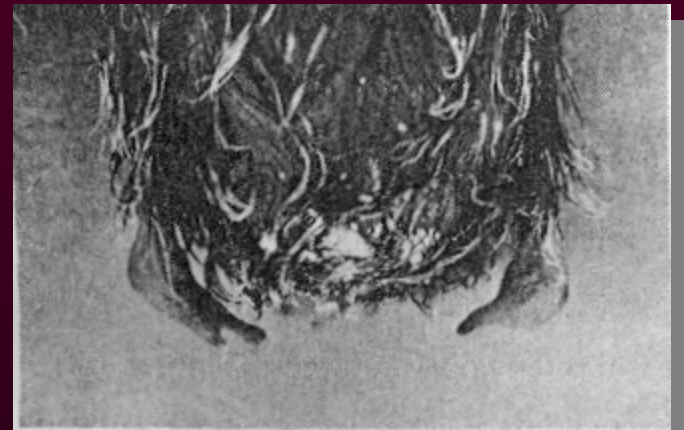
Objectives

- To describe the distribution of selenium and trace metals in sediment and biota among the different wetlands of the delta.
- To describe the concentrations organochlorine pesticides in biota from the delta wetlands.

- **Selenium** originates from Cretaceous marine sedimentary rock exposure in the Colorado River drainage.
- Although selenium is an essential micronutrient, concentrations not greatly exceeding those required may produce toxic effects.
- These effects may range from physical malformations during embryonic development to sterility and death.



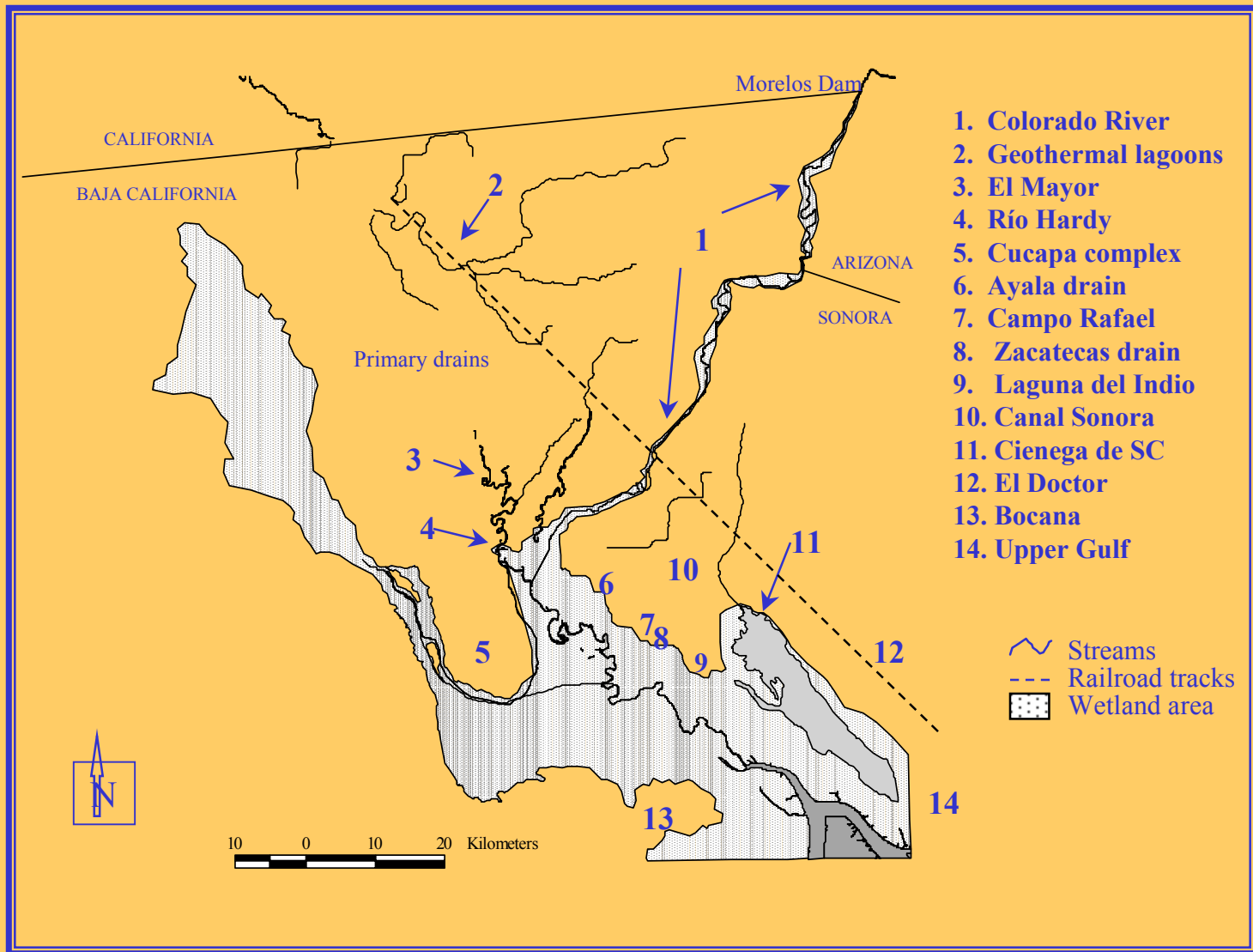
Deformed mosquito fish from Belews lake
(Lemly, 1993)



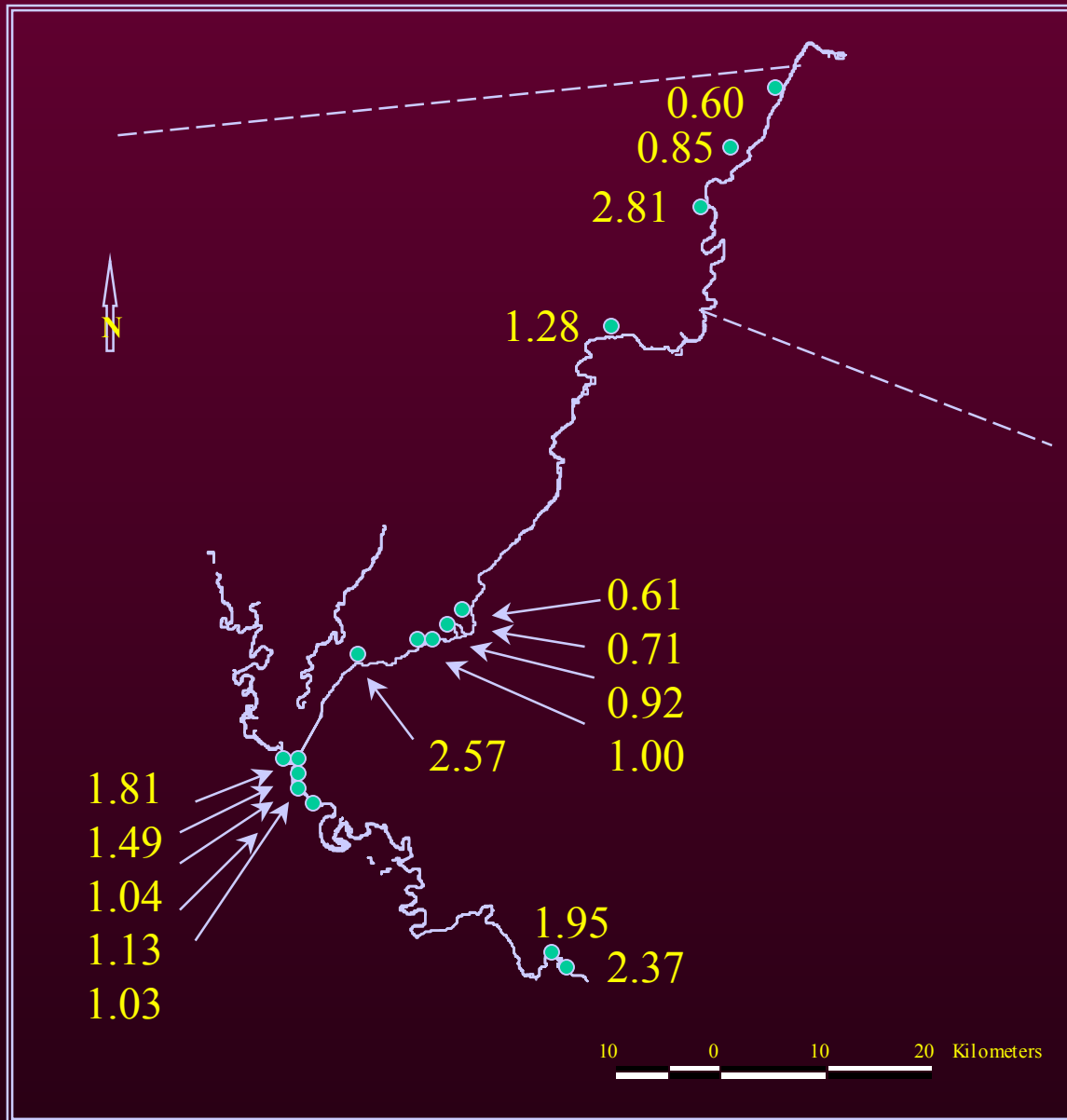
Abnormal embryos from Kesterson
(Ohlendorf, 1986)

Methods

- A total of 41 bottom sediment cores were collected from different sites within 12 major locations in the delta on April, 2000
- 98 composite samples of fish, invertebrates, insects and amphibians, were collected from 12 locations in the delta

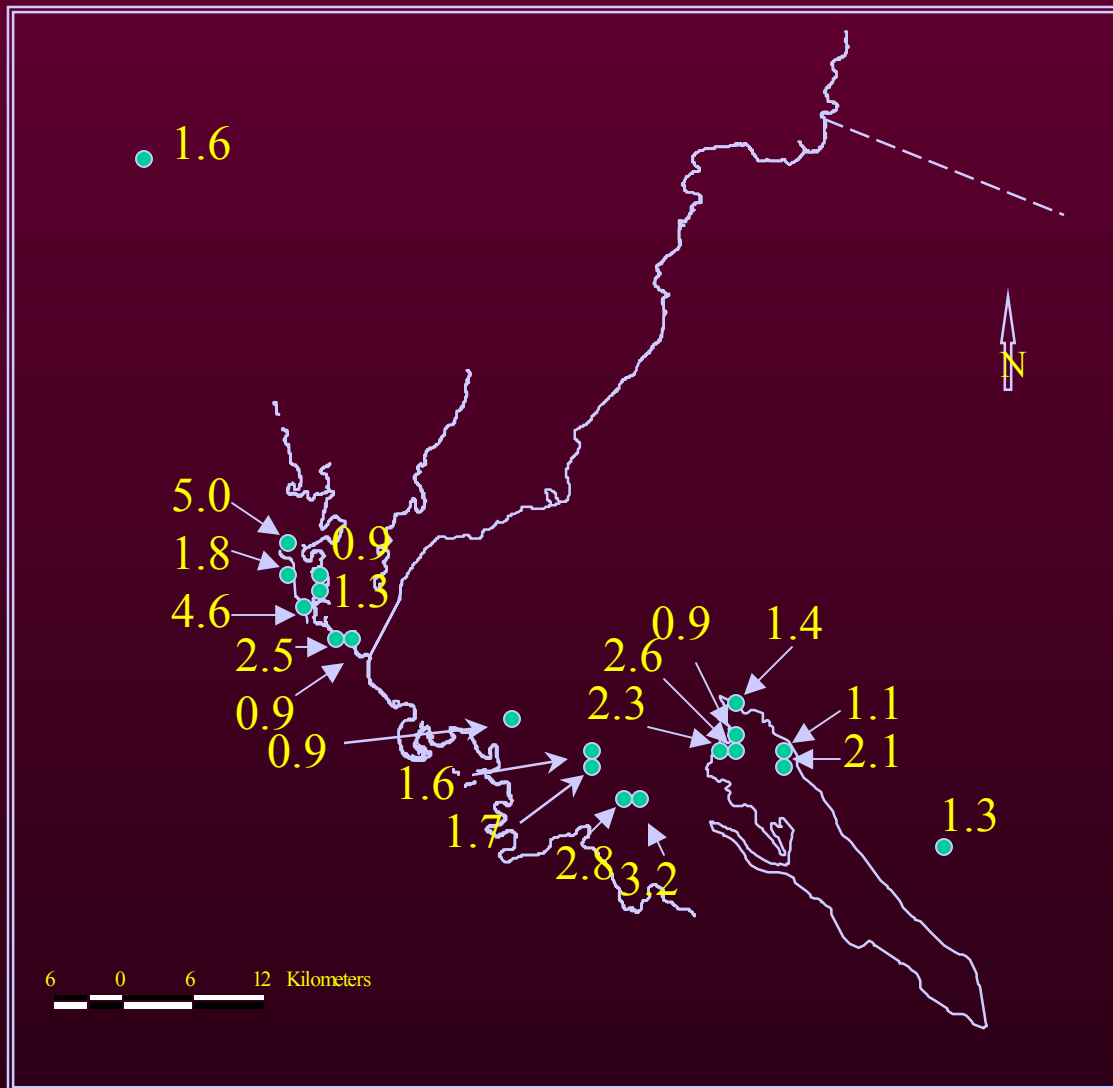


Results



Se conc.
in bottom
sediment
Samples
from the
Colorado
River sites
(ppm)

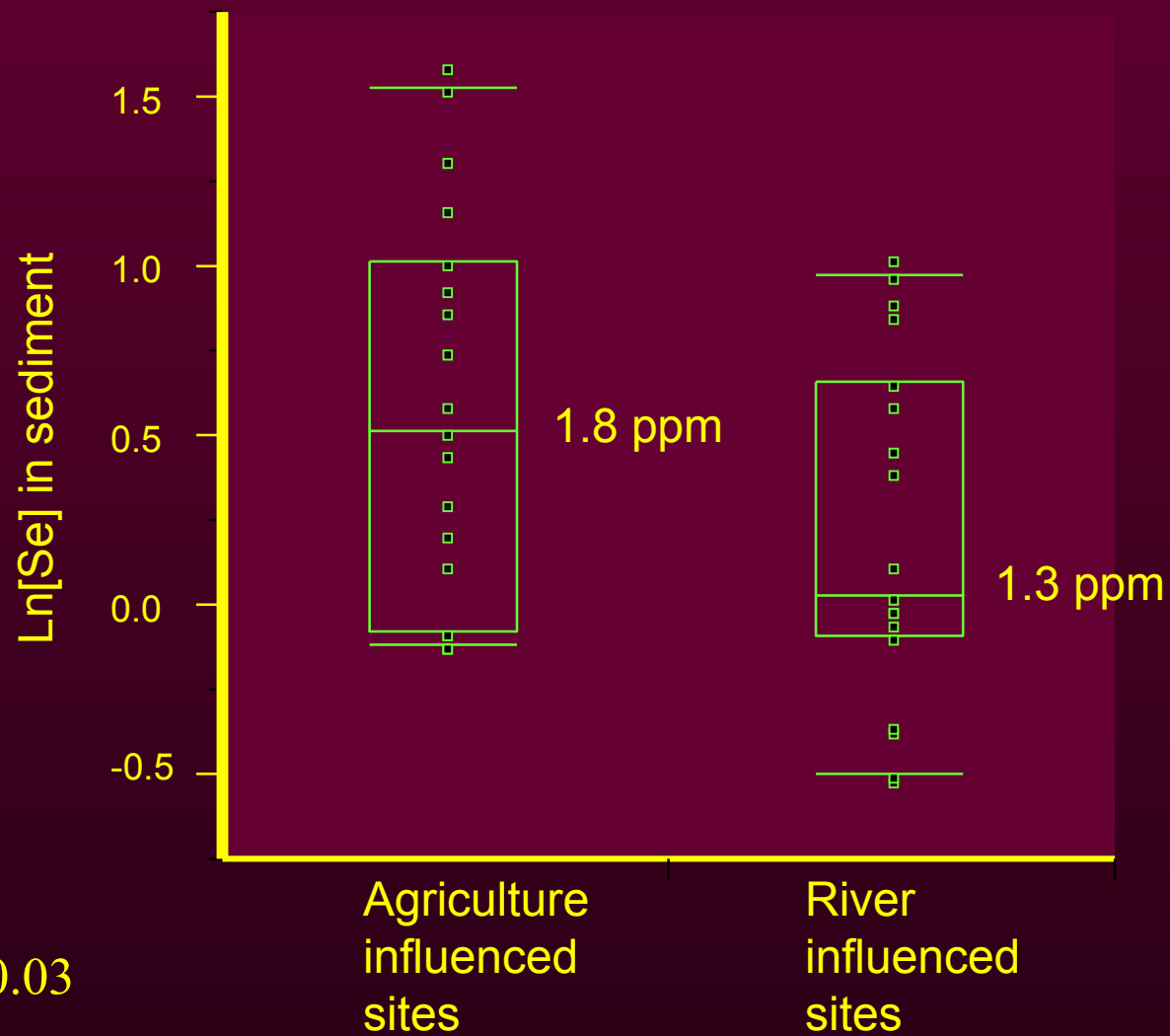
EC10 = 2.5 ppm
EC100 = 4 ppm



Se conc.
in bottom
sediment
from wetland
sites (ppm)

EC10=2.5 ppm
EC100 = 4 ppm

t-test
P-value = 0.03

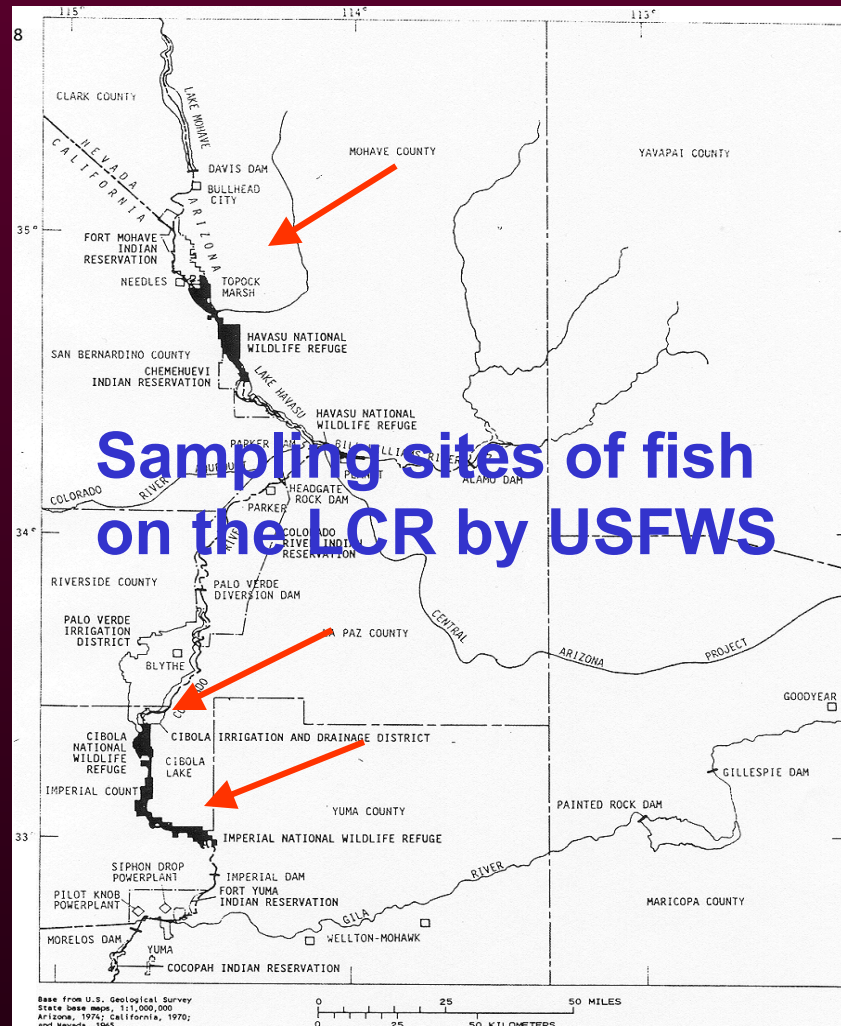


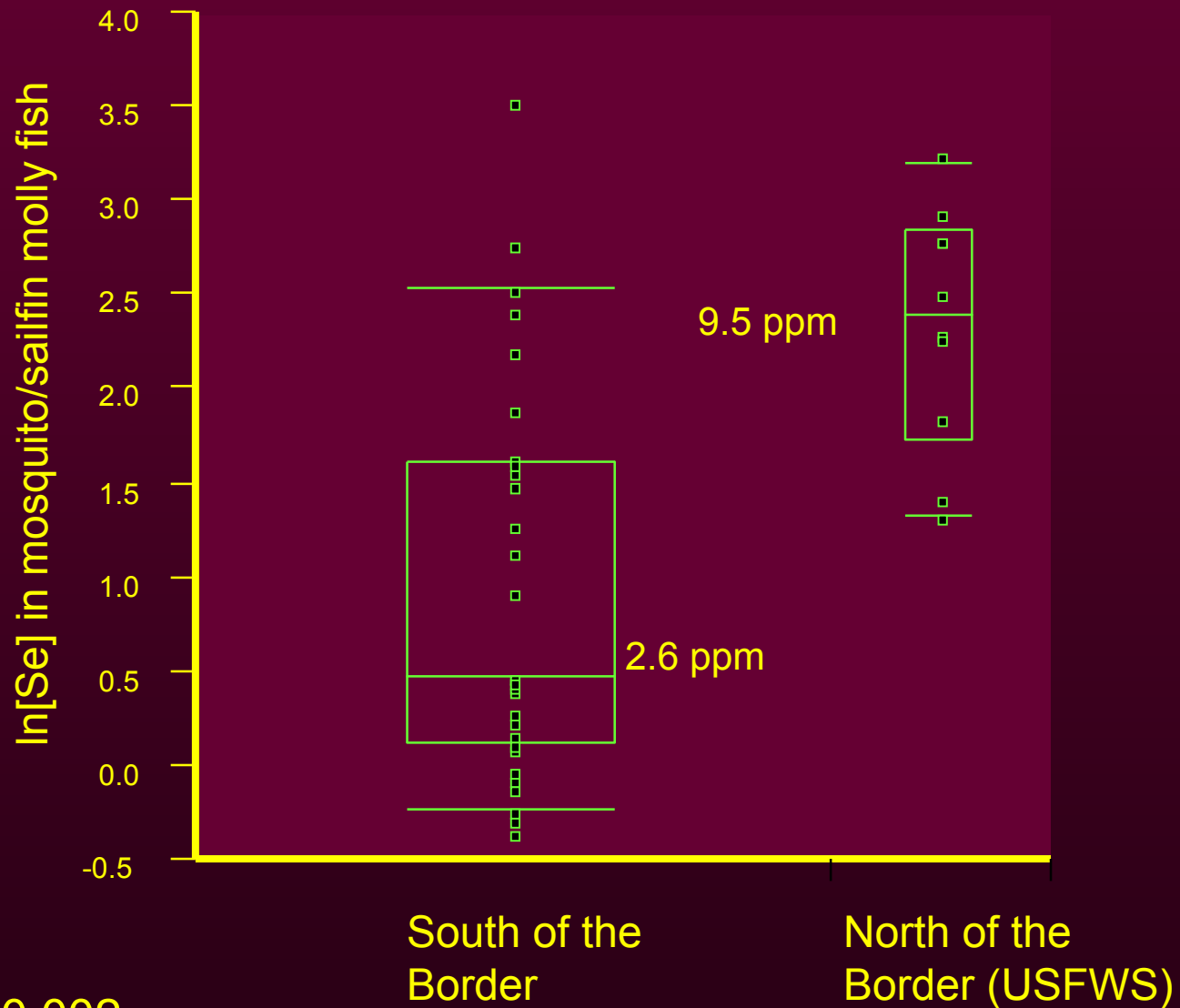
- The threshold for reproductive impairment in birds from dietary exposure is reported to be 3 ppm
- 23% of the samples exceeded this guideline.

Concentration of Se in biota (only values > than 3 ppm)

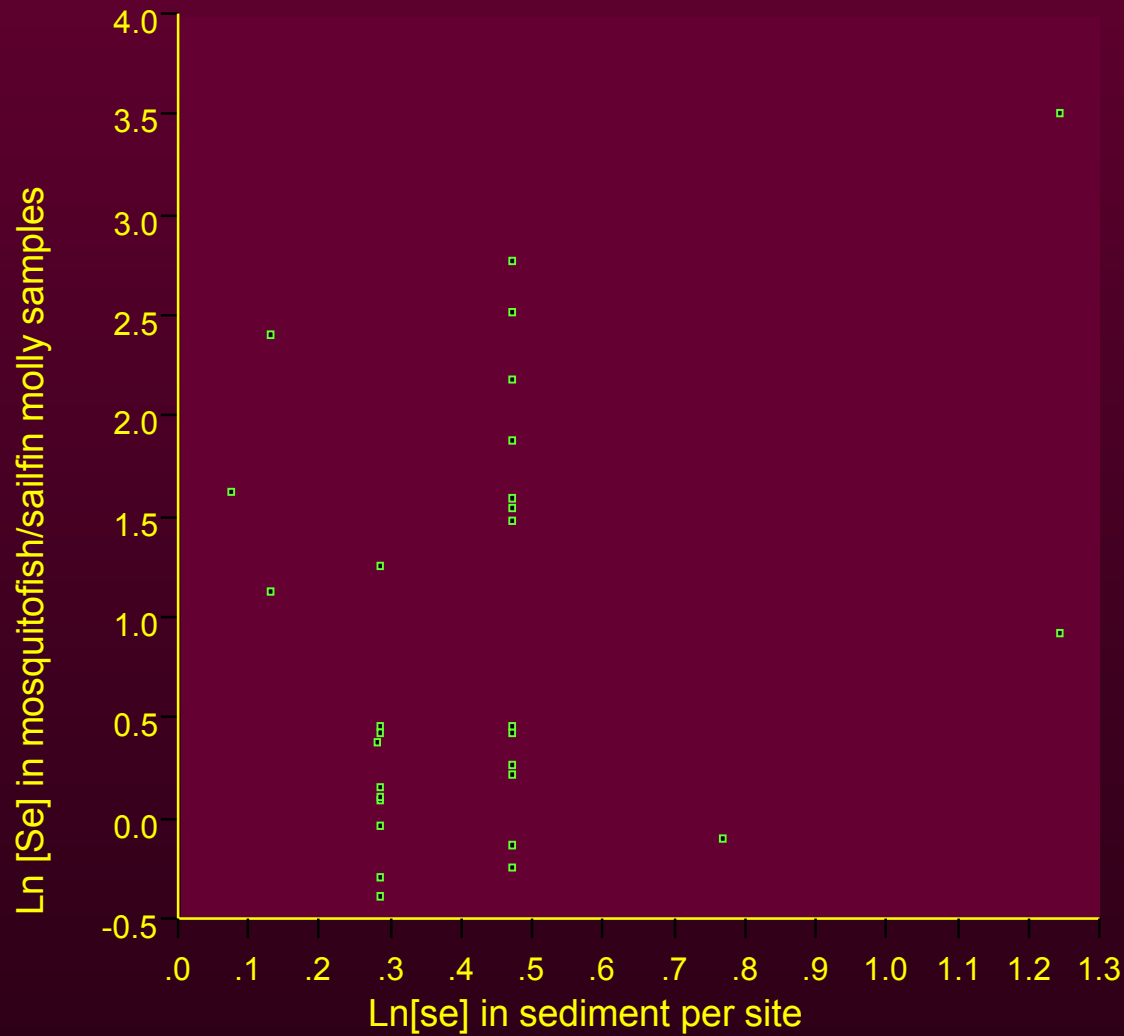
Site name	Sample	N	Se biota (ppm)	Se sed. (ppm)
El Mayor south	Mosquitofish	2	18.3	3.5
Bocana	Freshwat. shrimp	1	17.1	2.2
MODE	Sailfin molly	2	11.5	1.6
Cienega de SC	Sailfin molly	2	8.6	1.6
Colorado River	Mosquitofish	2	7.3	1.1
Campo Mosqueda	Mosquitofish	1	5.2	1.1
Cienega de SC	Brine shrimp	1	5.0	1.6
Campo Flores	Bullfrog	1	4.5	1.4
Campo Flores2	Stripped mullet	1	4.1	1.4
La Flor del desierto	Sailfin molly	4	4.0	1.6
Campo Flores	Tilapia	1	3.6	1.4
Cienega de SC	Crayfish	5	3.5	1.6

Comparison with Selenium concentrations in the Lower Colorado River north to the border:





t-test
P-value = 0.002



No relationship was found between Se conc. in fish and in sediments

➤ However, selenium content in sediment correlate well with:

- pH (P-value = 0.006) (+)
- % clay (P-value = 0.02) (+)
- % silt (P-value = 0.04) (+)
- % sand (P-value = 0.02) (-)
- % organic carbon (P-value =0.01) (+)

Concentration of other trace metals in biota (ppm)

	Cd	Hg	Pb
<i>Potential toxic threshold</i>	<i>0.4-1.0</i>	<i>0.3-1.6</i>	<i>100</i>
Range (N = 23)	<0.2-0.8	<0.04-1.3	<2.0-2.7
% that exceeded threshold	17% (0.4) 0% (1.0)	40% (0.3) 0% (1.6)	0%

Concentration of pesticides in biota (ppm wet wt.)

	DDE	DDT	DDE/DDT ratio
<i>Critical dietary conc.</i>	0.15-1.0		
% detected	86%	26%	
Range (N = 30)	<0.01-0.34	<0.01- 0.13	1-9.5
% Above threshold	30% (0.15) 0% (1.0)		

Conclusions

- Sites that received water from agricultural runoff, that had strongly reducing conditions, but that had some type of outflow or flushing system (*i.e.* tides) and that were mostly undisturbed, had the lowest concentration of Se in fish (*i.e.* southern portion from the Cienega de Santa Clara).

- Sites that received water directly from the Colorado River and that had mildly reducing or oxidizing conditions, low organic carbon and high sand content, were likely to have high Se concentrations in fish (*i.e.* Colorado River sites).

- The highest concentration of Se in fish resulted from sites that received agricultural runoffs but that had little or no outflow, high organic carbon and physical disturbance of the sediments such as dredging or subsequent periods of drying and flooding (*i.e.* MODE canal, south of the El Mayor wetland, Laguna del Indio).

Recommendations

- To closely monitor El Mayor wetland to determine if birds are being affected by the high selenium concentrations in sediments and food items
- To monitor reproductive success of Yuma Clapper rails from the Cienega de Santa Clara wetland, specially at the MODE

- The following measures could maintain Se concentrations below toxic thresholds:
 - Maintenance of an outflow
 - Preferential use of agricultural runoffs, or a mix of Colorado River and agricultural runoff
 - Restraint of mechanical perturbation of the sediments, such as dredging, specially at sites with no outputs
 - Avoidance of subsequent periods of drying and flooding

Needed Research

- Further analysis of the effects of pesticides on wildlife
- Groundwater analysis of organic and inorganic compounds
- The presence of fecal coliforms in the river, their effects on human health and possible solutions
- Eutrophication of the Delta due to fertilizers, effects, and possible solutions
- Unregulated industrial outflows into the sewage and the river, possible solutions

MUCHAS GRACIAS !

THANK YOU !

